US009255682B2

(12) **United States Patent**
Lai

(10) **Patent No.: US 9,255,682 B2**
(45) **Date of Patent: Feb. 9, 2016**

(54) **LASER LAMP SYSTEM FOR A VEHICLE**

(71) Applicant: **HON HAI PRECISION INDUSTRY CO., LTD.**, New Taipei (TW)

(72) Inventor: **Chih-Chen Lai**, New Taipei (TW)

(73) Assignee: **HON HAI PRECISION INDUSTRY CO., LTD.**, New Taipei (TW)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 290 days.

(21) Appl. No.: **13/926,388**

(22) Filed: **Jun. 25, 2013**

(65) **Prior Publication Data**

US 2014/0301098 A1 Oct. 9, 2014

(30) **Foreign Application Priority Data**

Apr. 3, 2013 (TW) ..... 102112212 A

(51) **Int. Cl.**
H01L 33/50 (2010.01)
F21S 8/10 (2006.01)

(52) **U.S. Cl.**
CPC ***F21S 48/1225*** (2013.01); ***F21S 48/1145*** (2013.01); ***F21S 48/13*** (2013.01)

(58) **Field of Classification Search**
CPC F21K 9/56; F21V 13/12; F21V 13/14; B60Q 1/04; H01J 1/62; H01J 1/70; G02B 5/0226
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,491,237	A *	1/1970	Tillett	250/458.1
5,208,462	A *	5/1993	O'Connor et al.	250/493.1
5,706,134	A *	1/1998	Konno et al.	359/599
6,068,383	A *	5/2000	Robertson et al.	362/84
6,469,322	B1 *	10/2002	Srivastava et al.	257/89
6,602,596	B2 *	8/2003	Kimura et al.	428/327
6,653,765	B1 *	11/2003	Levinson et al.	313/112
6,709,143	B2 *	3/2004	Harada et al.	362/558
7,906,892	B2 *	3/2011	Choi et al.	313/112
8,480,257	B2 *	7/2013	Shang et al.	362/255
8,637,883	B2 *	1/2014	Chakraborty	257/98
8,764,225	B2 *	7/2014	Narendran et al.	362/231
2007/0096113	A1 *	5/2007	Inoshita et al.	257/79

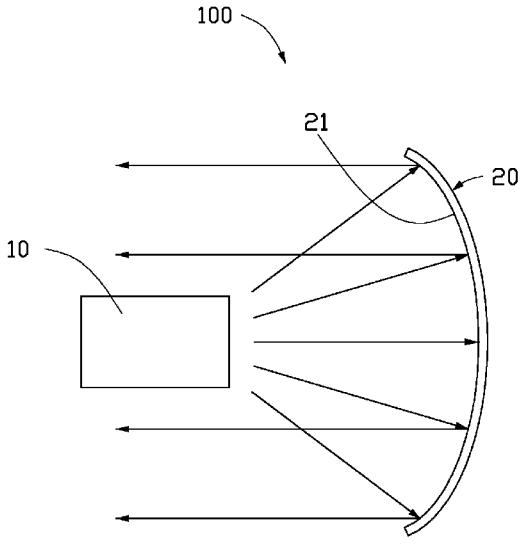
* cited by examiner

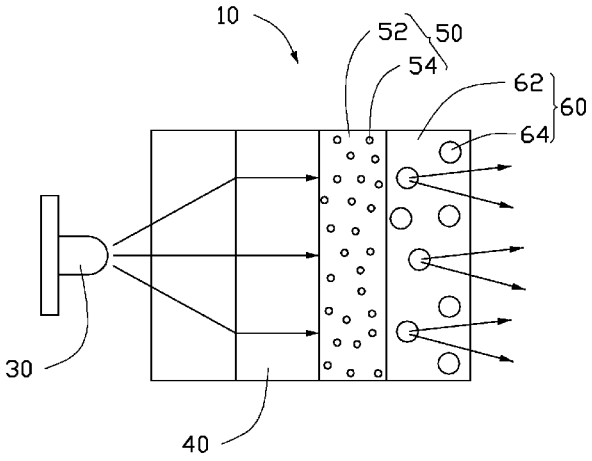
Primary Examiner — Ismael Negron
(74) *Attorney, Agent, or Firm* — Novak Druce Connolly Bove + Quigg LLP

(57) **ABSTRACT**

A lamp system includes a laser source and a reflecting plate for reflecting light generated from the laser source. The laser source includes a laser diode, a light splitter for splitting light generated from the laser diode into a plurality of beams, a phosphor layer for changing color of the beams transmitted from the light splitter, and a diffusing layer for diffusing the beams transmitted from the light splitter, to thereby form a surface light source. The lamp system is configured to be used in a vehicle.

16 Claims, 3 Drawing Sheets





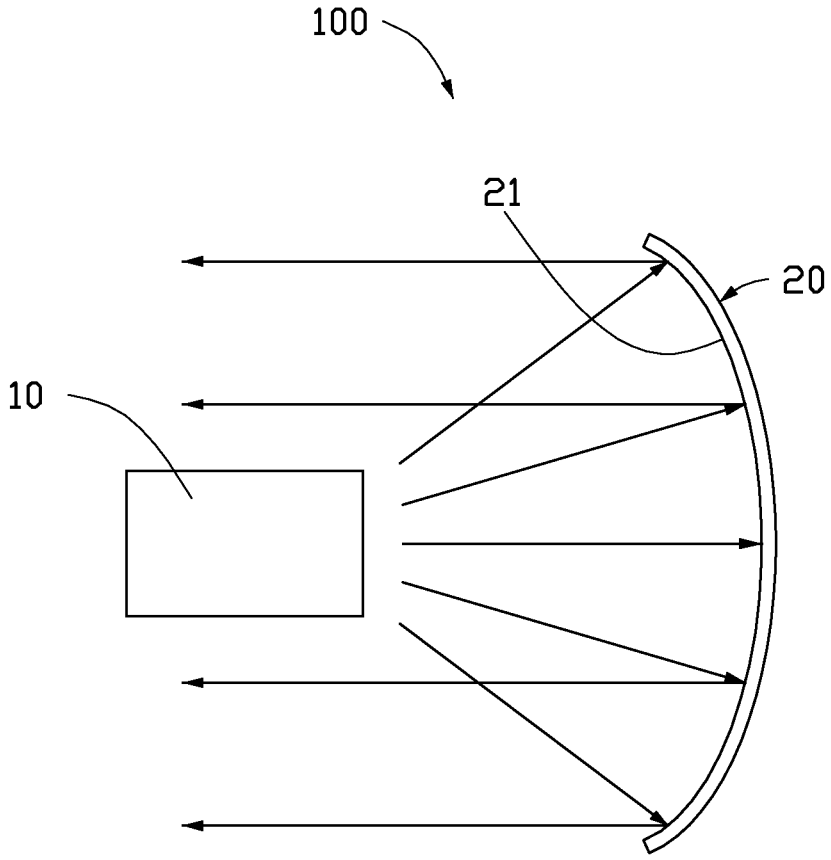


FIG. 1

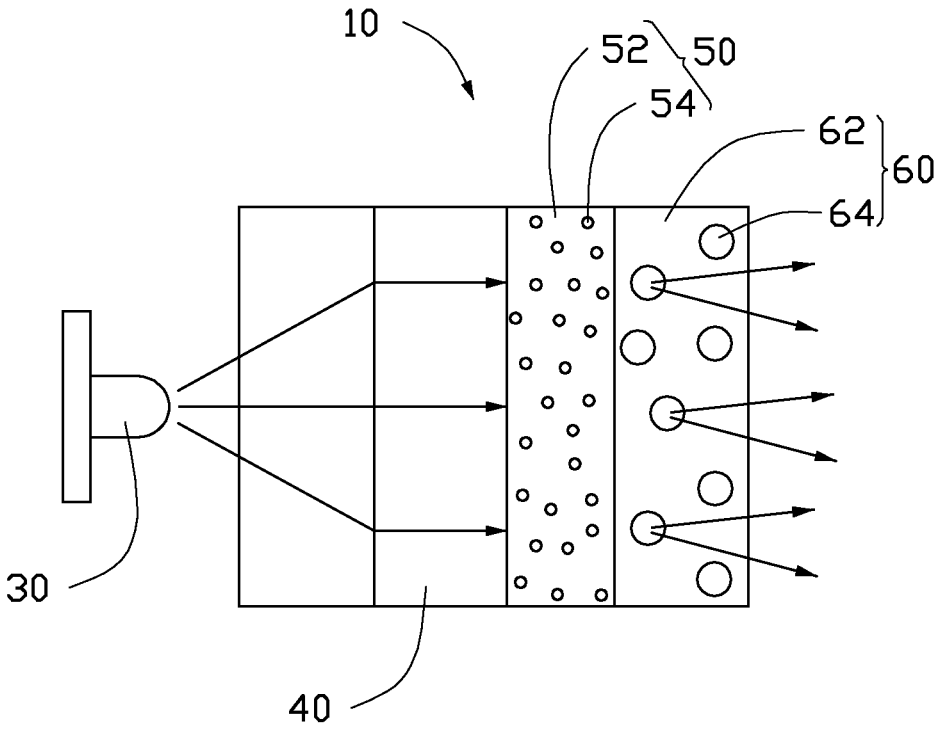


FIG. 2

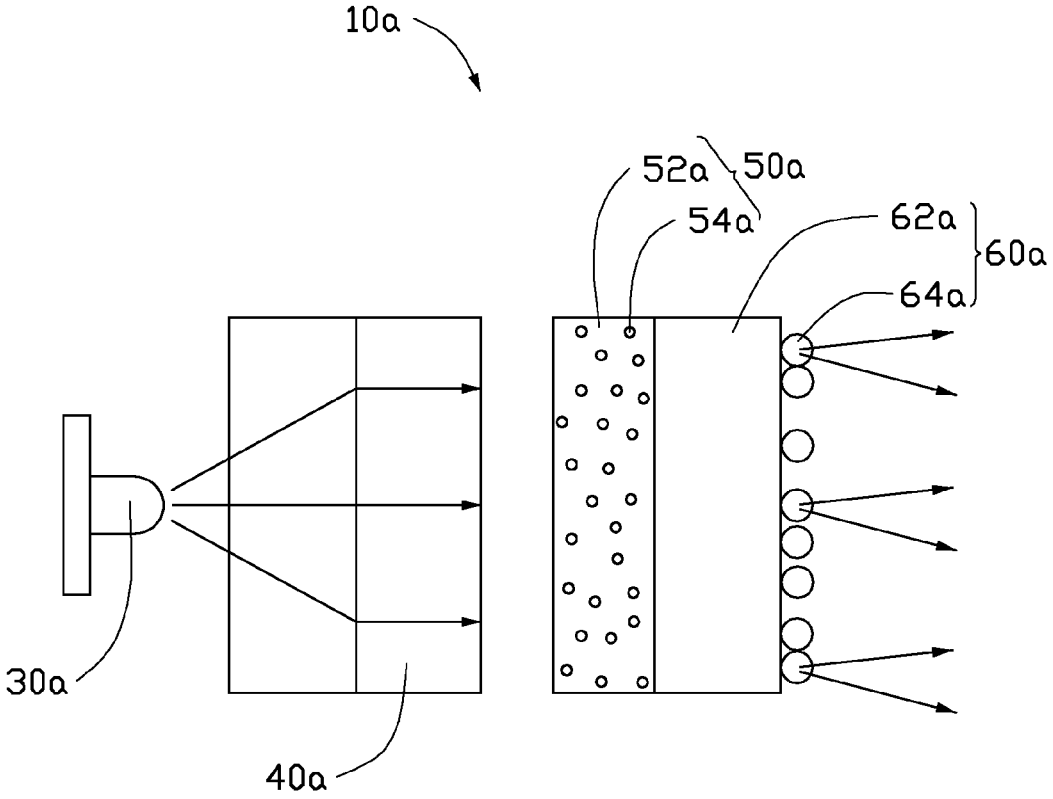


FIG. 3

LASER LAMP SYSTEM FOR A VEHICLE

BACKGROUND

1. Technical Field

The disclosure relates to an illumination system, and particularly to a vehicle lamp system with a high light utilizing efficiency.

2. Description of Related Art

A conventional vehicle lamp apparatus used in a vehicle provides illumination to by a halogen bulb cooperating with a parabolic reflecting mirror. However, the vehicle lamp apparatus using the halogen bulb as the light source has many shortcomings, such as poor light distributions, low light utilizing efficiency, etc.

What is needed, therefore, is a vehicle lamp system which can overcome the limitations described above.

BRIEF DESCRIPTION OF THE DRAWINGS

Many aspects of the present embodiments can be better understood with reference to the following drawings. The components in the drawings are not necessarily drawn to scale, the emphasis instead being placed upon clearly illustrating the principles of the present embodiments. Moreover, in the drawings, like reference numerals designate corresponding parts throughout the several views.

FIG. **1** is a schematic view of a vehicle lamp system in accordance with a first embodiment of the disclosure.

FIG. **2** is a schematic view of a laser source of the vehicle lamp system of FIG. **1**.

FIG. **3** is a schematic view of a laser source of a vehicle lamp system in accordance with a second embodiment of the disclosure.

DETAILED DESCRIPTION

Referring to FIG. **1**, a vehicle lamp system **100** in accordance with a first embodiment of the disclosure is shown. The vehicle lamp system **100** is disposed in a front portion of a vehicle for illuminating a road in front of the vehicle. The vehicle lamp system **100** includes a laser source **10** and a reflecting plate **20** for reflecting light generated from the laser source **10** out of the vehicle. The reflecting plate **20** is arc-shaped and has a concave reflecting face **21**. The reflecting face **21** faces light emitting direction of the laser source **10**.

Referring to FIG. **2**, the laser source **10** includes a laser diode **30**, a light splitter **40**, a phosphor layer **50** and a diffusing layer **60**.

The laser diode **30** is electrically connected with a storage battery in the vehicle to obtain electrical energy from the storage battery. In this embodiment, the laser diode **30** irradiates blue light when works.

The light splitter **40** is configured for splitting the light generated from the laser diode **30** into a plurality of beams. Compared with a number of laser diodes, splitting light generated from a single laser diode can greatly reduce chromatic aberration. The light splitter **40** is a passive device, and includes incoming and out coming slits, a reflecting mirror, and a chromatic dispersion component.

The phosphor layer **50** is configured for changing color of the beams transmitted from the light splitter **40**. The phosphor layer **50** is formed on an outer face of the light splitter **40** by means of spraying technique or printing technique. The phosphor layer **50** includes a nonopaque base **52** and phosphor powders **54** contained in an interior of the base **52**. The base **52** is made of optical grade resin or silica gel. In this embodiment, the phosphor layer **50** converts the light transmitted from the light splitter **40** into white light.

The diffusing layer **60** is configured for diffusing the beams transmitted from the light splitter **40**, to thereby form a surface light source with the light evenly distributed in a large illumination area. The diffusing layer **60** includes a nonopaque base **62** and diffusing grains **64**. In this embodiment, the diffusing grains **64** are contained in an interior of the base **62**. The base **62** is made of optical grade resin or silica gel. The diffusing grains **64** can be made of high nonopaque organic resin. The shape of the diffusing grains **64** can be spheric, aspheric, or cubic.

Referring to FIG. **3**, a laser source **10***a* of a vehicle lamp system in accordance with a second embodiment of the present disclosure is shown. The laser source **10***a* includes a laser diode **30***a*, a light splitter **40***a*, a phosphor layer **50***a* and a diffusing layer **60***a*. The phosphor layer **50***a* includes a nonopaque base **52***a* and phosphor powders **54***a* contained in an interior of the base **52***a*. The diffusing layer **60***a* includes a nonopaque base **62***a* and diffusing grains **64***a*. In the second embodiment, the phosphor layer **50***a* is spaced from the light splitter **40***a*, the diffusing grains **64***a* are formed on an outer face of the base **62***a* away from the phosphor layer **50***a* by means of spraying technique or coating technique.

According to the disclosure, the vehicle lamp system using the laser diode as light source, the light emitted from the laser diode passes through the light splitter, the phosphor layer and the diffusing layer in sequence, thereby converting the point type light source into the surface type light source with the light evenly distributed and a large illumination area. Thus, the light utilizing efficiency of the light generated from the laser diode is greatly enhanced.

It is believed that the disclosure and its advantages will be understood from the foregoing description, and it will be apparent that various changes may be made thereto without departing from the spirit and scope of the disclosure or sacrificing all of its material advantages, the examples hereinbefore described merely being preferred or exemplary embodiments of the disclosure.

What is claimed is:

1. A lamp system for providing illumination for a vehicle, comprising:

a laser source comprising a laser diode, a light splitter configured to split light generated from the laser diode into a plurality of light beams, a phosphor layer adapted to changing a color of the light beams from the light splitter, and a diffusing layer adapted to diffusing the light beams transmitted from the light splitter and to forming a surface light source, and the light splitter, the phosphor layer and the diffusing layer located at the same side of the laser diode; and

a reflecting plate configured to reflect light from the laser source out of the vehicle lamp system.

2. The lamp system of claim **1**, wherein the reflecting plate is arc-shaped and has a reflecting face, and the reflecting face being concave and facing a light emitting direction of the laser source.

3. The lamp system of claim **1**, wherein the diffusing layer comprises a nonopaque base and diffusing grains, and the diffusing grains are distributed in the base.

4. The lamp system of claim **3**, wherein the base is made of optical grade resin or silica gel.

5. The lamp system of claim **3**, wherein the material of the diffusing grains is nonopaque organic resin.

6. The lamp system of claim **3**, wherein a shape of the diffusing grains is spherical, aspherical, or cubical.

7. The lamp system of claim 1, wherein the diffusing layer comprises a nonopaque base and diffusing grains, and the diffusing grains are formed on an outer face of the nonopaque base away from the phosphor layer by means of spraying or coating.

8. The lamp system of claim 7, wherein the base is made of optical grade resin or silica gel.

9. The lamp system of claim 7, wherein the material of the diffusing grains is nonopaque organic resin.

10. The lamp system of claim 7, wherein a shape of the diffusing grains is spherical, aspherical, or cubical.

11. The lamp system of claim 1, wherein the phosphor layer is formed on an outer face of the light splitter by means of spraying or printing.

12. The lamp system of claim 11, wherein phosphor layer comprises a nonopaque base and phosphor powders distributed in the base.

13. The lamp system of claim 12, wherein the base is made of optical grade resin or silica gel.

14. The lamp system of claim 1, wherein the phosphor layer is spaced from the light splitter.

15. The lamp system of claim 14, wherein phosphor layer comprises a nonopaque base and phosphor powders distributed in the base.

16. The lamp system of claim 15, wherein the base is made of optical grade resin or silica gel.

* * * * *